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# Guidelines for Uniform Swine Improvement Programs

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## Acknowledgments

This publication outlines and encourages the use of uniform procedures for objectively measuring and recording swine performance data. These procedures can help improve the value of performance testing as a management tool.

The National Swine Improvement Federation (NSIF), in cooperation with the Science and Education Administration (SEA-Extension and SEA-Agricultural Research), U.S. Department of Agriculture, sponsored the development of this revised publication.

Many Extension specialists, researchers, testing organization members, and swine producers participated on NSIF committees in developing the guideline contents. Special appreciation is extended to the editorial committee (composed of O. Wayne Robison, North Carolina State University, who served as chairman and editor; Gene Isler, Ohio State University; Rodger Johnson and Bill Ahlschwede, University of Nebraska); and to Dr. Irvin T. Omtvedt, University of Nebraska; Dr. Charles J. Christians, University of Minnesota; and Dr. Roger J. Gerrits, SEA-Agricultural Research, for their assistance in compiling and critically evaluating the contents of this publication.

Special acknowledgments are due the progressive State, breed, and swine industry organizations that have placed swine performance testing in its proper perspective and encouraged its use by producers.

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*Program Leader-Animal Science*

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**Revised February 1981**



Preface

Research has shown that using objective evaluation measurements can substantially improve swine performance. Most economically important traits can be measured objectively and have sufficiently high heritabilities to allow improvement by selection. Formal testing programs for swine began in the United States in the 1950's. Central test stations (43) were established in 27 States from 1950 to 1975. A few States have also established on-the-farm testing programs.

Because these programs were developed independently, a number of differences exist among them in terminology, procedures, and methods of measuring and reporting performance information. These differences are recognized as barriers to acceptance and implementation of performance testing. The barriers have restricted cooperation among various segments of the swine industry in compiling and using performance records. Thus, the genetic and economic impact of performance testing on the swine industry has been restricted. Uniform methods of measuring and reporting performance data are needed urgently.

The need for standard methods of measuring and reporting swine performance data resulted in the organization of the National Association of Swine Testing Stations (NASTS) in 1974 to develop uniform standards for reporting swine performance data. On the basis of discussions and committee reports evolving from meetings of this organization, agreement on uniform guidelines for swine improvement within the swine industry became a distinct possibility. However, for such guidelines to be acceptable by the total swine industry, they would need to be formulated by a broad-based federation encompassing all organizations involved in swine performance recordkeeping.

NASTS prepared bylaws for a federation of national organizations involved in swine performance testing to develop guidelines for uniform swine improvement programs. On March 20, 1975, these organizations met at the American Pork Congress in Kansas City, Missouri, and approved the bylaws. This dissolved the National Association of Swine Testing Stations, forming the National Swine Improvement Federation (NSIF). The purposes of NSIF are:

**1. Uniformity.** To work for establishment of accurate and uniform procedures for measuring and recording data

concerning the performance of swine which may be used by participating organizations.

**2. Development.** To assist member organizations and/or their affiliates in developing their individual programs consistent with the needs of their members and the common goal of all recordkeeping programs.

**3. Cooperation.** To develop cooperation among all segments of the swine industry in compilation and utilization of performance records to improve efficiency in the production of swine.

**4. Education.** To encourage members to develop educational programs emphasizing the use and interpretation of performance data in improving the efficiency of swine production.

**5. Confidence.** To develop increased confidence of the swine industry in the economic potential of performance testing.

**Member organizations** include:

The *national registry associations* for eight breeds of swine: American Berkshire Association; American Landrace Association, Inc.; American Yorkshire Club, Inc.; Chester White Swine Record Association; Hampshire Swine Registry; National Spotted Swine Record, Inc.; Poland China Record Association; and United Duroc Swine Registry.

*National Pork Producers Council.*

*Central and on-farm swine testing organizations* from the following States:

Alabama	— Wiregrass Swine Evaluation Station — Southeastern Alabama Swine Evaluation Station
California	— California Swine Evaluation Station
Colorado	— Colorado Swine Growers Association
Florida	— Florida Swine Evaluation Center
Georgia	— Georgia Pork Producers Association
Indiana	— Indiana Boar Test Station
Iowa	— Farmland Industries — Iowa Swine Producers Association — Midland Cooperatives, Inc.
Kansas	— Kansas Swine Testing Station
Louisiana	— Louisiana Testing Station
Michigan	— Michigan Evaluation Station
Minnesota	— Minnesota Pork Producers Association

Mississippi	— Mississippi Swine Testing Station
Missouri	— University of Missouri Swine Testing Station
	— NWMO Swine Testing Station
Montana	— Montana Pork Producers Council
Nebraska	— Nebraska SPF Swine Accrediting Agency
	— Farmland Industries
	— SENEK Swine Test Station
North Carolina	— North Carolina Swine Evaluation Station
North Dakota	— Northern Purebred Swine Association
Ohio	— Ohio Pork Improvement Association
Oklahoma	— Oklahoma Swine Breeders Association
Pennsylvania	— Pennsylvania Meat Evaluation Center
South Carolina	— South Carolina Evaluation Center
South Dakota	— South Dakota Evaluation Station
Tennessee	— Tennessee Swine Testing Program
Virginia	— Virginia Evaluation Station
Wisconsin	— Midland Cooperatives, Inc.

**Associate memberships** are available to organizations, firms, public agencies, or individuals interested in swine performance programs.

**Ex-officio member organizations** are the North Central Swine Technical Committee; land-grant universities; and the U.S. Department of Agriculture, Science and Education Administration (SEA-Extension and SEA-Agricultural Research).

This publication was developed from reports of program and trait committees appointed by the Board of Directors of NSIF. It represents an effort on the part of the swine industry to extend the usefulness of performance testing.

The guidelines in this publication are a revision of the Guidelines for Uniform Swine Improvement Programs recommended by the National Swine Improvement Federation in November 1976. The guidelines will be reviewed periodically and updated as indicated by research, experience, and industry economics.

The National Swine Improvement Federation and the U.S. Department of Agriculture intend to show no preference for or discrimination against any individual breed of swine or organization.

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# Guidelines for Uniform Swine Improvement Programs

This publication outlines procedures for measuring and recording swine performance. It also strives to achieve greater uniformity of terminology and methods of measuring performance traits. This is important in accomplishing rapid and accurate communication to foster cooperation among all segments of the swine industry in compiling and using performance records.

Economic traits of swine include those that contribute to both productive efficiency and desirability of product. Growth rate, feed efficiency, reproductive efficiency, and carcass merit are the economic traits of greatest importance. Performance testing offers those engaged in swine production a way of measuring heritable differences among their animals in order to select parents that are expected to transmit their superior performance to their offspring.

Differences in performance among individuals or groups of animals are due to either genetic or environmental causes. The observed or measured performance of each animal in each trait is the result of its heredity and the total environment in which it is produced. Since differences among animals for economically important traits are due in varying degree to genetic reasons, systematic measurements, and use of records in selection can increase the rate of genetic improvement for many traits. Genetically superior individuals can be more readily identified when the animals are maintained under the same management systems and their performance records are adjusted for known environmental differences. There are many random or chance environmental variables that may contribute to errors in estimating breeding values of animals. This is one reason why heritabilities may be less than one.

The rate of genetic improvement is dependent on: (1) the percentage of observed differences between animals from genetic causes (heritability), (2) the difference between selected individuals and the average of the herd or group from which they come (selection differential), (3) the genetic association among the traits upon which selection is based (genetic correlations), and (4) the average age of parents when the offspring selected for the next generation are born (generation interval). Genetic progress per year may be illustrated by the following formula:

$$\text{Expected genetic progress} = \frac{(\text{heritability}) \times (\text{selection differential})}{\text{generation interval}}$$

Records of performance are primarily useful in providing a basis for comparing swine managed alike within a herd. Large environmental differences due to location, management, health, and nutrition are likely to exist among herds or

among different management groups within herds. Genetic differences among herds do exist, but only through a carefully controlled evaluation can these differences be assessed. To identify high-ranking individuals within a breed, it is necessary to first identify high-ranking individuals within herds. *Thus, widespread use of performance testing within herds is the first essential step to swine improvement.*

The principal features of effective record-of-performance programs are:

1. All animals of a given sex and age are given equal opportunity to perform through uniform feeding and management.
2. Systematic records of economically important traits on *all* animals are maintained.
3. Records are adjusted for known sources of variation.
4. Records are used in selecting replacements (boars and gilts) and in eliminating poor producers.

Profitability in a swine enterprise is influenced by many factors. Several traits may need to receive emphasis in a well-designed breeding program. The problem arises in determining the appropriate emphasis to place on each trait to allow for identification of the genetically superior animals.

Traits are measured in different units (number of pigs, pounds per day, inches, etc.), are not of equal economic importance, and are not genetically influenced to the same degree (different heritabilities). Each of these factors compounds the problem of determining the appropriate emphasis to apply to each trait in a breeding or selection program. The purpose of a selection index is to assign

appropriate emphasis to each of the various traits and to provide a single value to use in comparing different animals.

A second concept employed in NSIF improvement programs is that of expressing the level of performance as a ratio. Ratios simply involve the expression of each animal's performance relative to the herd or test group average. The trait ratio is:

$$\frac{\text{Animal's performance} \times 100}{\text{Average performance of all animals in the group}}$$

For example, a boar gaining 2.20 pounds per day from a group averaging 2.00 pounds per day has a daily gain ratio of  $(2.20 \times 100) \div 2.00 = 110$ . A ratio of 110 implies the boar is 10 percent above the test group average for that trait. Similarly, a ratio of 90 would indicate the boar performed 10 percent below the average of contemporary pigs tested. The index procedures recommended by NSIF result in index values that are similar to ratios.

Ratios allow individuals to be compared relative to contemporary groups. They are a useful method for comparing individuals that are not contemporaries, such as those in different tests, or for comparing different traits. While a deviation of 0.25 may not be important for one trait, it may be for another trait or for the same trait in a different test group. Generally, a ratio of 110 will have a similar meaning for different traits or different tests.

Trait ratios remove differences in average performance levels among groups (and generally among traits). Thus, they should allow for a more unbiased comparison among individuals that were tested in different groups. It must be remembered, however, that this is only true to the extent that average differences among groups are not genetic. Most differences among groups are due to feeding, weather, housing, management, etc.



## On-Farm Testing Program

### Purpose

The primary purpose of an on-farm performance swine testing program is to measure the performance of individuals and to use these performance records as the basis for selection and genetic improvement.

The on-farm testing program is designed to assist breeders in evaluating their herds in a systematic manner. The program will (1) identify superior individuals, strains, lines, or breeds; (2) assist breeders in the selection of boars and gilts; (3) provide a means of following up on the breeding value of boars purchased from central test stations; and (4) allow breeders to use common terminology and guidelines in selection of breeding stock.

### Testing Essentials

The objectives of the on-farm testing program can be met completely *only* if the whole herd is tested. Testing a selected sample of the herd yields limited and biased information. Comparisons are most meaningful if based on all the pigs produced so trait ratios and indexes are not distorted.

Accuracy is an extremely important part of any testing program. Most producers have the ability to adequately conduct performance tests. However, professional assistance from breed associations, testing organizations, Cooperative State Extension Services, and private commercial concerns is available to aid producers in the mechanics, record processing, and reporting of data connected with a testing program. Further, the involvement of an independent agent may provide assurance of accuracy and serve as motivation for the producer to collect and use the appropriate information.

Pigs should be evaluated within test groups and divided by farrowing group, month, or season. These test groups should be managed and fed uniformly. All pigs in the test group should be given an equal opportunity.

Each record should be expressed as a ratio of the test group or herd average. The individual's index should be used when ranking possible herd replacements.

### Procedures

Participating breeders in on-farm testing programs should meet the following criteria:

**1. Identification of All Pigs in Herd.** NSIF recommends the standard ear notching system that identifies the litter in the right ear and individual pig in the left ear. This system is shown in appendix 1. If another notching system is used,

the appropriate system should be stated and attached to the basic record document. Supplemental identification of eartags or tattoos may be used as optional herd identification.

**2. Birth Record.** Within 3 days of birth, all pigs will be individually ear notched, sex noted, and the birth date and parents recorded in an appropriate record book or file kept by the breeder. These records are essential.

**3. Sow Productivity.** The number of pigs farrowed alive and dead should be recorded. Litters should be standardized to between 8 and 10 pigs per litter within 24, but not later than 48, hours after birth. After standardization, record the number of pigs in the litter.

At 21 days, record litter weight and the number of pigs alive—all pigs raised by the sow, including foster pigs. An individual breeder may wean at any time, but litter weight should be collected before weaning and as near 21 days as possible. Litter weight at 21 days should be adjusted for number of pigs in the litter and age. Appropriate correction factors are presented in appendix 2.

### 4. Growth

*a. Postweaning Gain.* Pigs will be weighed on test at an average pen weight ranging between 40 and 60 pounds, with a range of 30 to 80 pounds for individual pigs. However, average off-test pen weight must be between 220 and 240 pounds. Individual pig off-test weight can range between 200 and 260 pounds. Actual beginning and ending test weight should be noted. Test daily gain will be used to compute days to 230 pounds.

*b. Age at 230 Pounds.* If pigs are not weighed on test but only a final weight is taken, pigs should be weighed between 200 and 260 pounds. Correction factors for adjusting days to a 230 pounds basis are given in appendix 2.

*c. Weight at an Age.* Because of the logistics of weighing pigs, some organizations use weight for age for evaluating pigs; e.g., weight at 140 or 154 days. Actual weights may be adjusted to a standard age. These weights may be used to estimate days to 230 pounds. See appendix 2 for appropriate adjustment procedures.

### 5. Body Composition

*a. Backfat.* All pigs will be measured for backfat thickness. Backfat will be evaluated on pigs weighing between 200 and 260 pounds and adjusted to 230 pounds. Backfat should be measured at the seventh rib (shoulder probe), at the middle of the loin (loin probe), and over the last rib. All probes should be taken 1½ inches off the midline. The probes should be averaged and adjusted to 230 pounds. See appendix 2 for adjustment procedures.

b. *Loin Eye Area (Optional)*. The loin eye area should be measured on pigs weighing between 200 and 260 pounds and adjusted to 230 pounds. Loin eye area is not included in any recommended selection indexes.

**6. Feed Efficiency (Optional).** Feed efficiency has been made optional because most breeders will be unable to collect meaningful records. If feed efficiency is measured, the number of pigs per pen, sex, and relationship among pigs in the pen must be noted.

a. Initial weight on test will be between 40 and 60 pounds for the pen average, with individual pigs between 30 and 80 pounds.

b. Off-test weight should be between 220 and 240 pounds for the pen average, with individual pigs in the range of 200 to 260 pounds.

c. Pigs must be evaluated in individual pens or in sire progeny groups.

**7. Genetic Abnormalities and Structural Soundness.**

All breeding stock that exhibit any *genetic* defect should be noted and culled.

**8. Health and Nutrition.** See appendixes 3 and 4.

**Indexes**

Recommended indexes for on-the-farm testing are presented in detail in appendix 5. The recommended general indexes are given below. If other indexes are used, a description of them should accompany the testing results.

**1. Sow Productivity Index.**

$$\text{Index} = 100 + 6.5 (L - \bar{L}) + 1.0 (W - \bar{W})$$

**2. General Index.** The following index should be used even when 21-day litter weight is not available.

$$\begin{aligned} \text{Index} = & 100 + 6.6 (L - \bar{L}) + .4 (W - \bar{W}) \\ & - 1.6 (D - \bar{D}) - 65 (B - \bar{B}) \end{aligned}$$

**3. Definition of Traits.**

L = number born alive.

$\bar{L}$  = average of test group for number born alive.

W = adjusted 21-day litter weight.

$\bar{W}$  = average of test group for adjusted 21-day litter weight.

D = adjusted days to 230 pounds.

$\bar{D}$  = average of test group for adjusted days to 230 pounds.

B = adjusted backfat at 230 pounds.

$\bar{B}$  = average of test group for backfat at 230 pounds.

those in this section are optional. Reports should include:

1. Number born alive ratio.
2. Adjusted 21-day litter weight ratio.
3. Adjusted days to 230 pounds ratio.
4. Adjusted backfat at 230 pounds ratio.
5. Index.

To standardize and develop uniformity in computerizing on-farm records, an example of the data is shown in appendix 6.

**Reports**

All reports should include ratios for the traits measured. Actual measurements are optional. Indexes in addition to



## Central Test Program

Central swine testing stations are locations where animals are assembled from several cooperating farms for evaluation of differences in performance traits under uniform conditions. Central stations are used primarily to (1) acquaint and educate producers with performance records, and (2) compare individual pigs' performance for rate of gain, feed conversion, and backfat. The most a central test station can offer is reliable records for comparisons among individuals within test groups.

### Procedures

#### 1. Entry Requirements:

- a. Individual pigs must weigh between 40 and 65 pounds and have a weight per day of age between 0.6 and 1.2 pounds.
- b. All pigs must be from brucellosis-free validated herds and must be accompanied by an official test station health certificate (appendix 7).
- c. Pedigrees for purebred boars must be in the hands of the test station manager by 35 days after entry.

#### 2. Testing Procedures.

- a. All pigs will be uniformly managed, treated, and fed a standard ration as shown in appendixes 4 and 7.
- b. A test pen may consist of one to four animals from one sire representing a maximum of two litters.
- c. Animals are to be tested by sex: boars, gilts, or barrows are to be tested in separate groups or pens.
- d. There will be a minimum of a 7-day adjustment period from entry into the station to on-test weight.
- e. The average on-test pen weight will be  $70 \pm 5$  pounds.
- f. Pigs will be taken off test when the pen averages between 220 and 240 pounds. On-test average daily gain will be used to adjust days to 230 pounds.
- g. Feed efficiency will be computed on an average pen weight of 230 pounds.
- h. Backfat is to be measured between 220 and 240 pounds. Backfat should be measured at the seventh rib (shoulder probe), at the middle of the loin (loin probe), and over the last rib. All probes should be taken  $1\frac{1}{2}$  inches off the midline. The probes should be averaged and adjusted to 230 pounds. See appendix 2.

### Indexes

Complete details about the recommended indexes are given in appendix 5.

1. For test pens including only one animal:

$$\text{Index} = 100 + 45 (G - \bar{G}) - 65 (F - \bar{F}) - 60 (B - \bar{B})$$

2. For test pens including more than one animal (full and half sibs):

$$\text{Index} = 100 + 60 (G - \bar{G}) - 75 (F - \bar{F}) - 70 (B - \bar{B})$$

3. For tests where only gain and backfat are measured:

$$\text{Index} = 100 + 110 (G - \bar{G}) - 105 (B - \bar{B})$$

G = average daily gain on test.

F = pen feed efficiency (Feed/Gain).

B = backfat adjusted to 230 pounds.

$\bar{G}, \bar{F}, \bar{B}$  = test group average for daily gain, feed efficiency, and backfat.

### Reports

**1. Initial Report.** A 35-day report will be sent to the consignor. This report will include information on weight, average daily gain, and other pertinent data the station manager may wish to include. This report will state that the information is not to be used in sale or advertising promotion. It is recommended that test station managers inform breed secretaries of the consignors with pigs on test and station sale dates.

#### 2. Final Report

- a. All traits included in the report shall be given as ratios. The report should contain average daily gain, feed efficiency, and backfat ratios as well as the index value. Reporting of other traits or actual values for gain, efficiency, and backfat is optional.
- b. Summary reports and sale catalogs shall include actual test-sale group averages for all traits reported under "a." All boars in the test-sale group, including those not making the sale, will be included in these averages.
- c. A standardized data sheet for recording central test station data is shown in appendix 3. This form is also suitable for computerization of data.

### Sale Qualifications

1. Only boars with an index of 80 or higher will be offered for sale. This will result in about 20 percent of all boars being culled. Stations may adopt higher standards.
2. Independent culling levels *should not* be used in determining an animal's acceptance in the sale.
3. Additional boars may be culled because of soundness or other considerations. *Caution:* These should be of a genetic nature or be so severe that a boar cannot function. (See Visual Appraisal section for further details.)



## Reproduction

The importance of efficient reproductive performance in the economical production of swine cannot be overemphasized. Thus, guidelines were developed in this section for improving reproductive performance.

### Procedures for Improving Reproductive Performance of Females

Identification of productive individuals within a herd is economically beneficial to all pork producers. The producer needs accurate records to identify superior females.

**1. Recommended Program.** The recommended program is presented in the on-farm test program section.

Litter sizes should be standardized within 24, but not later than 48, hours after birth.

Standardization is done:

- a. To eliminate the negative environmental effects of litter size in which a female is reared on her subsequent reproductive ability.
- b. To facilitate accurate measures of mothering ability as assessed by 21-day litter weight.

Litter weights are obtained at about 21 days of age because:

- a. It is the age that best reflects the female's milking potential.
- b. In practical production, few pigs are weaned prior to 21 days due to rebreeding problems associated with early weaning.
- c. The intake of creep feed prior to 21 days should be negligible and should have minimal effect on the data. However, if creep feed is offered, it is important that litter weights be obtained by 21 days of age.

**2. Minimum Program.** Producers not following the recommended program may accomplish some progress by the following procedures.

- a. Identify all litters at birth by ear notch.
- b. Record the number of live pigs born in each litter.
- c. Select replacement gilts from the largest litters. Standardize litters to 8 to 10 pigs by transferring males from the large litters to small litters.
- d. Score litters at weaning based upon the following guidelines:

3 = Pigs large and uniform.

2 = Pigs average in size and/or lack uniformity.

1 = Pigs small and/or lack considerably in uniformity.

Select replacement gilts from litters scoring 3 or 2.

### 3. Essential Traits for Both Programs

- a. Farrowing ease.

*Score 5* — Farrowed and cleaned with no outside stimulus and less than 10 percent stillborn.

*Score 4* — Farrowed and cleaned with oxytocin injection and/or less than 20 percent stillborn.

*Score 3* — Needed physical assistance or up to 30 percent stillborn.

*Score 2* — Needed repeated assistance and/or more than one-third stillborn.

*Score 1* — Required caesarean or died during or shortly after farrowing.

- b. Select gilts with 12 or more apparently functional teats. Cull all gilts with inverted nipples.

c. Visual appraisal. About 10 percent of gilts have abnormal reproductive tracts. Some indication of these may be obtained by visual inspection.

(1) An infantile vulva may indicate the gilt has an underdeveloped reproductive tract.

(2) An upturned or "tipped" vulva may suggest an abnormal tract. Also, boars may have more difficulty in servicing these gilts.

### 4. Postweaning Management of Gilts.

a. At the end of the postweaning gain test, energy intake of the selected gilts should be restricted to prevent overweight conditions. Nutrients other than energy should be provided to meet the minimum daily recommended allowances of the National Research Council. (See the National Academy of Sciences publication, *Nutrient Requirements of Domestic Animals No. 2: Nutrient Requirements of Swine*, Eighth Revised Edition, 1979.)

b. Moving gilts to new pens, increased exercise, and daily exposure to boars beginning between 160 and 180 days of age will help stimulate the onset of estrus. Breeding should be delayed until the second or third estrus to increase the probability of large litters.

c. Drugs and hormone treatments to initiate the onset of estrus and improve reproductive performance, particularly in seedstock herds, are to be discouraged.

d. Gilts that do not conceive after mating at two estrus periods should be marketed. Likewise, gilts that have not conceived by 10 months of age should be culled.

### 5. Evaluation of Sow Herd Reproductive Performance.

Although not a selection criterion, this system may allow the producer to monitor total herd reproductive perfor-

mance. It requires monthly inventories of the breeding herd and number of pigs produced.

Pigs per sow per year =

$$\frac{\text{Total number of pigs at 21 days}}{\text{Average monthly sow inventory}}$$

Gilts should be included in the monthly herd inventory when they are picked for replacements at 6 months of age, not at the date when they are bred.

### Procedures for Improving Reproductive Performance of Males

1. *Minimum* age for off-test delivery of boars to buyer — 5½ months.

2. Age is an important criterion for sexual maturity and reproductive performance. *Minimum* age for successful breeding — 7½ months.

3. Boars should be managed as follows to maximize their chances for successful breeding.

a. Upon completion of test, boars should be fed at a level of energy that will prevent excessive fat deposition. This practice may help to insure that boars are physically adept and sexually active. Nutrients other than energy should be provided to meet the minimum daily recommended allowances of the National Research Council.

b. Boars tested individually or in small groups in close confinement should be managed to develop physical hardening and to stimulate sexual arousal and libido. Where possible, this should be done before delivery and might include the following:

(1) Shifting boars to a different location.

(2) Regrouping with other boars in larger pens or outside lots. Boars should be observed closely during the initial period of contact, and ample space should be provided.

(3) Providing fenceline contact with cycling females. This may be especially important where the aggressiveness of the boars precludes mixing them together.

c. Boars tested in large groups and in less confined settings will require less physical conditioning and sexual stimulations before use but may still benefit from some of the management procedures described for boars reared in close confinement.

### Management of Newly Purchased Boars

1. Transport newly purchased boars in a well-bedded, covered truck.

2. After delivery, boars should be isolated in clean, comfortable quarters for a minimum of 30 days. During this isolation, boars should be acclimated to the environmental

conditions (dirt, confinement, fluctuating temperatures, sunlight, etc.) in which they are expected to function during breeding.

3. Feed them only 3 or 4 pounds of feed daily for the first week.

4. If a boar doesn't make the adjustment to his new environment satisfactorily, call the breeder immediately for assistance.

5. After this initial adjustment period, producers should implement the following procedures:

a. Provide protection against certain major disease organisms. New breeding stock introduced to the farm (if not vaccinated) should be blood tested after 21 days in isolation for pseudorabies, brucellosis, eperythrozoonosis, and leptospirosis. (See appendixes 4 and 7 for further details.)

b. Evaluate boars for reproductive soundness early in the contact period (see below).

6. After the period of isolation and before breeding, the boars should be provided 3 to 4 weeks of fenceline contact with nonpregnant breeding females so the females may contract any new microorganisms brought in by the boars and the boars may be introduced to any microflora on the farm. This will provide sufficient time to recover from any illness caused by the new disease organisms before breeding. The boars and females should both be observed closely during this period for elevated body temperature or clinical signs of disease.

7. *Claims of Nonperformance.* The buyer should have at least 90 days from date of purchase to claim an adjustment.

### Evaluating Boar Reproductive Soundness

For fair evaluation of reproductive soundness, boars should be at least 7½ months of age. The evaluation should be completed before the breeding season so problem boars may be identified and culled.

1. **Mating behavior** may be evaluated by bringing a gilt in standing heat into the boar's pen and observing the following:

a. *Libido:* Observe the boar's aggressiveness and desire to mate. Boars may need assistance through at least one mating experience.

b. *Mounting:* Boars must have the ability to mount correctly. Boars may be interested in mounting but will not because of lameness, arthritis, or an injury. Boars that mount the front end of a gilt should be gently moved to the proper position for a few matings.

c. *Mating:* Observe the boar's ability to erect the penis and



properly enter the gilt. Examine the boar's penis for normal size and condition. Penis abnormalities occasionally encountered are: (1) adhered or tied penis, (2) limp penis, (3) infantile penis, and (4) coiling of the penis in the diverticulum. These conditions may be heritable, and boars exhibiting these problems should not be used in herds producing breeding stock.

**2. Semen.** A few boars do not produce sperm cells. The simplest way to collect semen from a boar is to put a rubber glove (latex) on one hand. Allow the boar to mount a gilt in standing heat. After the boar begins to extend his penis, firmly grasp the corkscrew end of his penis and bring the penis gradually forward. Collect the entire ejaculate into a wide-mouth container covered with a double layer of cheesecloth to keep the gel fraction separate. The volume of semen obtained from boars is quite variable but averages between 200-250 milliliters (about 1 cup). If the sperm concentration is high, the semen will be milky in appearance. Boars with watery or bloody semen should be evaluated by a reproduction specialist. Usually 70 to 80 percent of the sperm should be motile immediately after collection. However, low sperm motility is not a serious matter unless the condition persists for several months. Boars that produce semen with no sperm or only a few sperm should be rechecked several times at weekly intervals. If the condition persists, the boar should be culled.

**3. Test Matings.** To complete the soundness evaluation, two or three gilts should be bred and carefully checked to see whether they return to estrus within 4 weeks. Boars may be exposed to conditions or microorganisms on the new farm which may produce temporary infertility. High environmental temperatures, stress of transportation, illness, lameness, or injuries causing high body temperature can alter sperm motility and reduce fertility for up to 8 weeks.

NSIF recommends that an 18 percent protein ration be fed to boars throughout the test period. Calcium and phosphorus levels should be 0.95 percent and 0.85 percent, respectively. All rations should be analyzed to assure that recommended nutrient levels are actually attained in the ration. A suggested ration is presented in appendix 4. Other cereal grains may be substituted for corn, but general ration guidelines should be adhered to as closely as possible. The protein content of the diet may be reduced at test midpoint (approximately 100 pounds or 35 days after initiation of test) to 16 percent crude protein for boars and gilts, as long as all pigs in a test group are fed the same ration.

After the test, animals may be placed on a reduced energy intake. However, the ration should contain adequate minerals and vitamins to meet the animals' daily requirements.

Collection of feed efficiency data is encouraged where possible. If feed efficiency is measured, two litter mates per pen are suggested. When larger groups are maintained, they should be litter mates or at least from the same sire.

For detailed recommendations on evaluating and selecting for growth and efficiency of gain, refer to the on-farm testing and central test programs and appendixes 2 and 5.

## Carcass Evaluation

Swine producers can obtain carcass evaluation data on their hogs through several sources such as meat processing plants, locker plants, and home slaughter. NSIF recommends that an impartial and experienced individual collect or advise in the collection of this data. Independent of where carcass evaluation is done, the success of data collection is vastly improved through prior planning with all personnel involved (e.g., slaughter plant management, inspectors, scientists, county agents, etc.).

### Procedures to Evaluate Market Hogs

**Identification.** Tattoo with approved edible ink at two locations on each side of the pig. If pigs are skinned, tags can be clipped to both ears. Before the head is removed, remove tags, place in a plastic bag, and securely pin to the foreshank.

**Inspection.** When possible, the individual in charge of inspection should record and provide producers with information concerning abnormalities. Even though carcasses may pass inspection, some abnormalities may exist (e.g., parasite infestations, jowl abscesses, arthritis, cryptorchidism, atrophic rhinitis, etc.). This data cannot be collected in all slaughter operations. However, when it can, producers should be informed of these conditions and any other considerations that are important in evaluating the performance of their hogs.

**Hot Carcass Weight.** If chilled weights are recorded, convert to a hot weight basis by dividing by 0.985. For skinned carcasses, adjust to a skin-on basis by dividing the hot skinned carcass weight by 0.94. If a carcass is trimmed during the slaughter process, the amount of trim loss should be estimated by a knowledgeable person. If the trim is not excessive, the estimated weight should be added to the hot carcass weight. If major trimming is encountered (e.g., loss of a shoulder or ham due to arthritis condemnation), no attempt should be made to estimate and record data.

**Ribbing the Carcass.** The vertebra of the untrimmed carcass is first cut perpendicular to the long axis of the loin between the 10th and 11th ribs or between the 6th and 7th ribs, depending upon which method described in the following quantitative section is used. Start adjacent to the 11th or 7th rib to permit a square cut across the loin muscle without cutting into the 10th or 6th rib (avoid dished or beveled cuts because they distort loin eye area). After the vertebra is sawed, use a knife and extend the cut no more than 1 inch beyond the outer end of the loin eye surface (cutting further will damage the belly for bacon production). Ribbing should be done only on properly chilled carcasses (5-6 hours or more after slaughter), and it should be completed a minimum of 30 minutes prior to visual examination. It is recommended that ribbing be done by experienced slaughter plant personnel or other qualified individuals.

### Methods of Evaluating Quantitative Characteristics

To determine the proportionate amount of lean or muscle, one of the following four methods (listed in order of preference) is recommended, with the specific methods often depending on circumstances in the cooperating slaughtering facility.

**Method 1** includes hot carcass weight, fat depth, and loin eye area at 10th rib.

**1. Fat depth.** Divide the longest axis of the loin muscle into quarters. Measure the fat depth opposite a point three-fourths of the distance along the long axis toward the belly. The measurement is taken in tenths of inches from the edge of the muscle to the outer edge of and perpendicular to the skin. For skinned carcasses, add 0.1 inch to the measurement.

**2. Loin eye area.** This measurement is taken in square inches by using a clear plastic grid (Grid AS-235 is available from Iowa State University, Ames, IA). Loin eye area is determined by measuring the cross-sectional area. The area also can be measured by tracing the perimeter of the loin eye muscle on acetate paper and using a compensating polar planimeter to measure the area on the tracing paper.

**3.** The following equation estimates pounds of muscle:

$$\begin{aligned} \text{Pounds of muscle} &= 2 \\ &+ (\text{hot carcass weight, pounds} \times 0.45) \\ &+ (10\text{th rib loin eye area, square inches} \times 5) \\ &- (10\text{th rib fat depth, inches} \times 11). \end{aligned}$$

To determine percentage of lean in the carcass, divide pounds of muscle by hot carcass weight, and multiply by 100. This calculation also applies to the three subsequent methods.

**Method 2** combines hot carcass weight, fat depth, loin eye area, and seam fat score at sixth rib to estimate pounds of muscle.

**1. Seam fat scores.** Scores range from 1 to 5, including 1 = slight; 2 = small; 3 = moderate; 4 = abundant; and 5 = very abundant. Photographs of these scores can be obtained by requesting the centerfold of *Procedures to Evaluate Market Hogs* (published by the National Pork Producers Council, P.O. Box 10383, Des Moines, IA 50306, September 1976).

**2. Pounds of muscle = 4.5**

$$\begin{aligned} &+ (\text{hot carcass weight, pounds} \times 0.47) \\ &+ (\text{loin eye area, square inches} \times 6.4) \\ &- (\text{fat depth, inches} \times 5.8) \\ &- (\text{seam fat score} \times 2.5). \end{aligned}$$

**Method 3** includes hot carcass weight, skinned-defatted ham weight, and average backfat.



**1. Skinned-defatted ham weight.** The ham is removed from the carcass at a point half the distance between the anterior tip of the aitch bone and the last lumbar vertebra. The line of cutting is perpendicular to the long axis of the limb. The foot is removed by cutting parallel to the cut that separates the ham and loin and is made through the center of the tip of the hock. The tail (posterior to the last sacral vertebra), all skin, and all external fat are removed. The ham is weighed to the nearest tenth of a pound.

**2. Average backfat thickness.** This includes the average backfat measured opposite the first rib, last rib, and last lumbar vertebra. Each measurement is made to the nearest tenth of an inch, perpendicular to and including the skin, and includes only the middle and outer layers of fat exposed on the split surface of the backfat. If the skin has been removed, add 0.1 inch to adjust to a skin-on basis.

**3. Use the following formula:**

$$\begin{aligned} \text{Pounds of muscle} &= 15.3 \\ &+ (\text{hot carcass weight, pounds} \times 0.3) \\ &+ (\text{skinned-defatted ham weight, pounds} \times 2) \\ &- (\text{average backfat thickness, inches} \times 7.75). \end{aligned}$$

**Method 4** uses hot carcass weight and average backfat thickness to estimate pounds of muscle by the following:

$$\begin{aligned} \text{Pounds of muscle} &= 21.3 \\ &+ (\text{hot carcass weight, pounds} \times 0.55) \\ &- (\text{average backfat thickness, inches} \times 17.75). \end{aligned}$$

**Carcass Standards**

**1. Carcass weight.** Minimum hot carcass weight of 140 pounds (131 pounds if skinned). Maximum trimming loss because of on-farm causes will vary according to circumstances. If excess trimming causes difficulty in estimating weight loss or making measurements, the carcass should be disqualified.

**2. Carcass length.** Carcass length is measured in as straight a line as possible, from the anterior tip of the aitch bone to the anterior edge of the first rib and next to the vertebra. The longest side should be used to determine carcass length.

**3. Backfat and loin eye area.** Maximum backfat and minimum loin eye standards are optional. When these standards are deemed necessary, adjustments should be made to a standard weight using the facts presented in appendix 2.

**4. Breed certification standards.** Different breeds may wish to emphasize different traits. Variable standards allow each breed to maximize selection for a given set of characteristics and thus achieve different goals.

**Ranking Procedures**

1. Determine age of pigs in days.
2. Determine total pounds of muscle in carcass by using the suggested equation.
3. Determine the number of age units required to produce 85 pounds of muscle. Use the following equation:

$$\text{Age units required to produce 85 pounds of muscle} = \frac{(85 \times \text{age at slaughter, days}) - 5100}{\text{Pounds of muscle}} + 60$$

4. If market gilts are evaluated, the age units required to produce 85 pounds of muscle should be adjusted by subtracting two age units for gilts.

5. If market pigs are evaluated in a central test station, pounds of muscle per day on test may be used. The initial pounds of muscle for a pig on test is approximately 40 percent of its live weight. A pig weighing 40 pounds is estimated to have 16 pounds of muscle (containing 10 percent fat).

The equation used to calculate pounds of muscle per day on test is:

$$\frac{\text{Final test pounds muscle} - \text{Initial test pounds muscle}}{\text{Days on Test}}$$

If difference existed in on-test weight, the daily muscle gains should be corrected by adding 0.002 for each pound below average on-test weight and subtracting 0.002 for each pound above average on-test weight.

6. *Events which rank carcasses on the basis of percent lean without growth data are discouraged.* However, if performance data are not available and carcass rank is desired, percent lean should be adjusted to a 160-pound carcass basis by the following formula:

$$\begin{aligned} \text{Percent lean at 160 pounds} &= \\ \text{percent lean} &- [0.057 \times (160 - \text{carcass weight})] \end{aligned}$$

If the average carcass weight of this group is different than 160 pounds, adjust percent muscle to that weight.

**Qualitative Characteristics**

**Muscle color.** Pork muscle should be bright grayish pink to pinkish red. Individual muscles are usually uniform in color, but muscle groups next to each other often display considerable variability in color.

Muscles that are too pale or too dark are objectionable in appearance in retail trade. Abnormally pale muscles quickly turn gray in the retail display case and often shrink considerably. The five color scores (1 = pale, 2 = slightly



## Visual Appraisal

pink, 3 = grayish pink, 4 = slightly dark red, and 5 = dark red), shown in *Procedures to Evaluate Market Hogs* (NPPC), represent normal variation of pork color. It is recommended that carcasses having either of the two extreme color scores be disqualified from carcass competition.

**Muscle firmness and texture.** If the loin is soft and watery, displaying obvious fluid accumulations on its surface, and exhibiting a loose, coarse texture, the carcass should be eliminated from competition.

**Intramuscular fat.** Marbling is visible fat within the boundaries of loin muscle. The five marbling scores (1 = traces, 2 = slight, 3 = small, 4 = moderate, and 5 = abundant) shown in *Procedures to Evaluate Market Hogs* (NPPC), represent normal variation of pork marbling. Slight to moderate amounts are desired to provide a juicy and flavorful cooked product. Where marbling requirements are used, it is recommended that carcasses possessing traces (1) or abundant (5) quantities of marbling be disqualified from competition.

National Swine Improvement Federation guidelines were developed to encourage the collection and utilization of objective measures of performance to improve swine production. Additional criteria that are not objectively measured should be scored. Structural soundness and underline soundness are examples of such traits which affect production and reproduction.

### Feet and Leg Soundness

It is recognized that breeding animals must be structurally correct and mobile to carry out their normal functions. Limited research suggests soundness is at least moderately heritable. The following recommendations are offered as aids in selecting replacement animals. The animals should be evaluated at or near the end of test and prior to conditioning. Date of appraisal should be noted.

Scoring format:

1. **Unacceptable** (1-3 points). Severe structural problems that restrict animal's ability to breed.
2. **Good** (4-7 points). Animals with slight structural and/or movement problems.
3. **Excellent** (8-10 points). No obvious structural or movement problems. (Includes even toe size, adequate length of stride, adequate flexion of hock and pastern cushion, trueness and freeness of movement.)

### Underline Soundness

Sows must have functional nipples to rear pigs. The role and heritability of spacing, prominence, location, etc., of nipples in production has not been defined clearly by research. However, since these traits may have a direct influence on production, their consideration may be justified.

Scoring format:

1. **Unacceptable** (1-3 points). Fewer than six functional nipples on each side or one or more inverted nipple.
2. **Good** (4-7 points). Six or more functional nipples on each side with adequate spacing and prominence.
3. **Excellent** (8-10 points). Six or more functional nipples on each side, well-spaced and well-developed with no pin or blind nipples.

### Porcine Stress Syndrome (PSS)

PSS is probably caused by homozygous recessive genes at a single locus. When stressed, animals afflicted by this syndrome have splotchy coloring, breathe heavily, have tail tremor, and often die. Such animals and their sires and dams should be culled.

## Merchandising

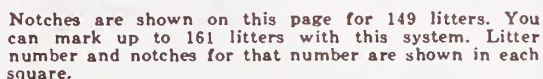
Animals affected by PSS may appear shorter-bodied and smaller in stature than their normal herd mates. They may be more muscular in appearance with "groove-shaped" loins, indentations in their rumps, and a circular shape to the hams. A separation between the major muscles of the ham is often evident. Dilation of the pupils and tremor of the tail are often observed following exposure to physical stress. However, it must be cautioned that not all heavy-muscled pigs are affected by PSS.

Effective merchandising depends on the integrity of the breeder, coupled with the use of well-defined terms relating to the product to be sold. Standardized terminology relative to swine improvement has been developed through the National Swine Improvement Federation. Use of standard terms found in this publication is very important for communication throughout the swine industry and is strongly encouraged by NSIF in advertising and merchandising performance-tested swine.

The National Swine Improvement Federation strongly opposes the use of misleading statements that may be deceptive, make impossible claims, or use only selected portions of the total record in the merchandising of performance-tested swine. The use of misleading information is detrimental to the whole concept of performance testing. Therefore, NSIF strongly recommends that member organizations exert every possible effort to inform and educate swine producers to use NSIF recommended standards in advertising and merchandising their performance-tested swine.



## Ear Notching System To Identify Litters And Pigs In Litter

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## Appendix 2. Adjustment Factors

### 1. Adjustments for Live Measurements

#### LITTER WEIGHT AT 21 DAYS

1. Adjustment for age when weighed.

Adjusted weight =  $b$  (actual weight)

Age	$b$	Age	$b$	Age	$b$
14	1.29	19	1.07	24	.91
15	1.24	20	1.03	25	.88
16	1.19	21	1.00	26	.86
17	1.15	22	.97	27	.84
18	1.11	23	.94	28	.82

2. Adjustment for number nursed.

To adjusted weights given above:

a. For gilts — add 9 for each pig under litter size 10 after standardization.

b. For sows — add 10 for each pig under litter size 10 after standardization.

If number of pigs after standardization is more than 10, *do not* adjust.

#### ADJUSTMENT OF SOW PRODUCTIVITY FOR PARITY

Adjust sow productivity index to sow equivalent by adding 25 to a gilt's index. For second or later litters, no adjustment is necessary.

#### DAYS TO 230 POUNDS

Adjusted days to 230 = actual age

$$+ (230 - \text{actual weight}) \left( \frac{\text{actual age} - 38}{\text{actual weight}} \right)$$

#### BACKFAT AT 230 POUNDS

Adjusted backfat = actual backfat

$$+ (230 - \text{actual weight}) \left( \frac{\text{actual backfat}}{\text{actual weight} - 25} \right)$$

### 2. Adjustment for Carcass Traits

Adjustments for carcass traits are suggested as guides. These adjustment factors are the most accurate available at the present time.

Trait	Multiplication Factor
Length	.033 inch per pound
Loin-eye area	.013 square inch per pound
Backfat	actual backfat
	$+ (230 - \text{actual weight}) \left( \frac{\text{actual backfat}}{\text{actual weight} - 25} \right)$

### Appendix 3. Example Standardized Data Sheet — Central Test

BREED	BREEDER	ADDRESS	ZIP CODE	PEN
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[illegible]



## Appendix 4. Nutrition

The nutritional regimen of the animal greatly influences the results of swine testing programs. This section helps establish suitable nutrient levels for desirable performance.

### Nutrient Program

1. The ration fed should contain the following:

Nutrient	Percentage or amount per pound of ration
a. Crude protein	18%
b. Metabolizable energy	1400 kcal
c. Calcium	0.95%
d. Phosphorus (total ration)	0.85%
e. Iodized salt	0.50%
f. Trace minerals (in addition to those from ration ingredients)	
(1) Zinc	56.8 mg (125 ppm)
(2) Iron	45.4 mg (100 ppm)
(3) Copper	6.8 mg ( 15 ppm)
(4) Manganese	18.2 mg ( 40 ppm)
(5) Selenium	0.04 mg ( 0.1 ppm)
g. Vitamins (in addition to vitamins from diet ingredients)	
(1) Vitamin A	2000.0 I.U.
(2) Vitamin D	400.0 I.U.
(3) Riboflavin	2.0 mg
(4) Niacin	12.0 mg
(5) Pantothenic Acid	8.0 mg
(6) Vitamin B <sub>12</sub>	10.0 mcg
(7) Vitamin E	10.0 I.U.
(8) Vitamin K	2.0 mg
(9) Choline	100.0 mg

2. An example of a test station diet formula appears at the end of this appendix.
3. The metabolizable energy level of the suggested ration should be adequate. Fat *is not* to be added to the ration.
4. It is recommended that a feed additive, effective and approved by Food and Drug Administration (FDA), be used

throughout the test period. All withdrawal requirements are to be strictly followed.

5. Meal-form diets may be more practical for on-the-farm testing programs, but pelleted diets are preferred.

6. If the protein content of the diet is to be reduced at the test midpoint (approximately 100 pounds or 35 days after initiation of test), a 16-percent crude protein diet should be fed thereafter.

7. Generally, energy levels should be reduced after the conclusion of the test. It is recognized, however, that boars vary in their energy requirements. It is suggested that a conditioning ration can be made by substituting 500 pounds oats, 300 pounds wheat bran, or 200 pounds beet pulp for an equal amount of corn in the test ration.

### Example Test Station Diet Formula<sup>1</sup>

Ingredient	Amount (Pounds/Ton)
Ground yellow corn (8.9% crude protein)	1,280
Soybean meal (44% crude protein) <sup>2</sup>	557
Molasses <sup>3</sup>	25
Pellet binder <sup>3</sup>	50
Dicalcium phosphate (24% Ca; 18.5% P)	56
Ground limestone (38% Ca)	10
Salt (iodized)	10
Trace mineral mix <sup>4</sup>	2
Vitamin mix <sup>5</sup>	10
	<hr/> 2,000

1/ Calculated analysis: 18.0% crude protein; 0.94% calcium; 0.85% phosphorus; and 1381 kcal metabolizable energy/pound of diet (calculations considered corn as the carrier for vitamins and metabolizable energy values for corn and soybean meal as 1500 kcal and 1475 kcal, respectively). The test diet should be formulated so the calcium-phosphorus ratio is at, or near, a 1.2:1 ratio.

2/ Three pounds of synthetic lysine and 97 pounds of corn could be used to replace 100 pounds of soybean meal.

3/ Molasses and pellet binder level may be varied according to needs for proper pelleting.

4/ Amount of trace mineral mix used may vary but should add 125 ppm zinc, 100 ppm iron, 15 ppm copper, 40 ppm manganese, and 0.1 ppm selenium per pound of completed feed.

5/ Amount of vitamin mix may vary depending upon the amount of vitamin carrier used but should add the following vitamins/ton of complete feed: Vitamin A - 4,000,000 I.U.; Vitamin D - 800,000 I.U.; Riboflavin - 4.0 gm; Niacin - 24 gm; Calcium Pantothenate - 16 gm; Vitamin B<sub>12</sub> - 20 mg; Choline - 200 gm; Vitamin E - 20,000 I.U.; and Methylene Sodium Bisulfite (or equivalent Vitamin K source) - 4.0 gm. It is recommended that the vitamin carrier be finely ground corn. Antibacterial agents are to be added at approved levels.

## Appendix 5. Selection Indexes and Trait Ratios

Environmental differences make it difficult to compare pigs tested at different locations, at different times, or under different management. However, using standard indexes based on contemporary group comparisons and trait ratios removes much of the influence of these environmental factors. Thus, more valid comparisons of genetic merit are possible.

### On-Farm Program

1. Parameter estimates used in construction of the selection indexes.

Trait		Heritability	Standard Deviation	Economic Value
Number born alive (L)		.15	2.50	3.90
Adjusted 21-day litter weight (W)		.20	15.00	.50
Days to 230 lbs. (D)		.25	12.00	-.10
Backfat probe (B)		.50	.15	-3.50
Feed efficiency (F)		.35	.25	-9.00

		Genetic Correlations				
		L	W	D	B	F
Phenotypic Correlations	L	-	.40	-.30	0	-.20
	W	-.10	-	0	0	0
	D	.10	0	-	-.25	.70
	B	0	0	-.20	-	.30

### 2. Selection Indexes

General:  $I = 100 + 6.6(L - \bar{L}) + .4(W - \bar{W}) - 1.6(D - \bar{D}) - 65(B - \bar{B})$

Maternal:  $I = 100 + 7.6(L - \bar{L}) + .5(W - \bar{W}) - 1.5(D - \bar{D}) - 45(B - \bar{B})$

Paternal:  $I = 100 + 5.2(L - \bar{L}) + .3(W - \bar{W}) - 1.8(D - \bar{D}) - 80(B - \bar{B})$

The general index is recommended for maximum overall improvement and should be used even if 21-day litter weights are not available.

The maternal index is intended to put extra emphasis on maternal characteristics; e.g., litter size and 21-day litter weight.

The paternal index puts extra emphasis on growth, efficiency, and backfat. It would be appropriate for paternal lines to be used in terminal crosses.

It should be noted that feed efficiency is selected for in all of these indexes through its correlation with the other traits. It is included in the definition of the selection objective.

Sow Productivity Index:  $I = 100 + 6.5(L - \bar{L}) + 1.0(W - \bar{W})$

Comparisons among sows with varying numbers of litter records may be accomplished more accurately by using the following formulas.

Most Probable Sow Productivity (MPSP) is the best estimate of the future production of the sow. It is estimated by:

$$MPSP = 100 + b(\text{average sow index} - 100).$$

Breeding Value for Sow Productivity (BVSP) is the best estimate of the genetic capability for sow productivity that the sow will transmit to her offspring. It is estimated by:

$$BVSP = 100 + c(\text{average sow index} - 100).$$

The values "b" and "c" vary according to the number of litter records a sow has produced. The appropriate values for various numbers of records are given below:

Number of Litter Records	b	c
1	.25	.20
2	.40	.32
3	.50	.40
4	.58	.46
5	.63	.50
6	.67	.53

### Central Test Program

1. Parameter estimates used in construction of the indexes.

Trait	Heritability	Standard Deviation	Economic Value
Average daily gain (G)	.30	.20	4.00
Feed efficiency (F)	.35	.26	9.00
Backfat probe (B)	.50	.18	3.50

		Genetic Correlations		
		G	F	B
Phenotypic Correlations	G	-	-.70	.25
	F	-.50	-	.30
	B	.25	.15	-

### 2. Selection Indexes

a. Test pen includes only one animal.

$$I = 100 + 45(G - \bar{G}) - 65(F - \bar{F}) - 60(B - \bar{B})$$

b. Test pen includes more than one animal (full or half sibs).

$$I = 100 + 60(G - \bar{G}) - 75(F - \bar{F}) - 70(B - \bar{B})$$

c. Feed efficiency is not available.

$$I = 100 + 110(G - \bar{G}) - 105(B - \bar{B})$$

## Appendix 6. Standard Reporting Form — On-Farm Program

These indexes will average 100 for each test and should have a standard deviation of about 25. The test group should have approximately the following distribution:

Index Value	Percent of Animals
More than 150	2
125 to 150	14
100 to 125	34
75 to 100	34
50 to 75	14
Less than 50	2

The indexes place about 31 percent of the emphasis on gain, 32 percent on fat, and 37 percent on efficiency.

### Ratios and Contemporary Groups

Pigs should be evaluated within test groups and divided by test-sale, farrowing, month, or season. These test groups or comparison groups should be managed uniformly. All pigs in a test group should be given an equal opportunity. In the preceding indexes, it is assumed the averages refer to contemporary averages.

Ratios should be reported so those over 100 indicate performance better than contemporaries. Examples:

$$\text{Gain ratio} = 100 + \left( \frac{G - \bar{G}}{\bar{G}} \right) \times 100$$

$$\text{Efficiency ratio} = 100 + \left( \frac{\bar{F} - F}{\bar{F}} \right) \times 100$$

$$\text{Backfat ratio} = 100 + \left( \frac{\bar{B} - B}{\bar{B}} \right) \times 100.$$

### Sow Productivity

#### Data Input

1. Sow identification (ear notch, eartag, or registration number)
2. Sire of sow identification (ear notch, eartag, or registration number)
3. Sire of litter identification (ear notch, eartag, or registration number)
4. Breed of sow
5. Breed of sire of litter
6. Litter identification
7. Sow family identification
8. Parity of dam (number of litters produced)
9. Date litter farrowed
10. Number born — alive
11. Number born — total
12. Number after standardization
13. Number pigs at 21 days (include foster pigs)
14. Actual litter weight
15. Date litter weight obtained

#### Data Output

1. Include items 1-10 in Data Input
2. Adjusted 21-day litter weight
3. Sow productivity index
4. Most Probable Sow Productivity (MPSP) — see appendix 5
5. Breeding Value for Sow Productivity (BVSP) — see appendix 5
6. Contemporary group average
7. Sow family summary
8. Sire of sow summary
9. Sire of litter summary



### Individual Performance

#### *Data Input*

1. Sire identification
2. Sow identification
3. Breed of sire
4. Breed of dam
5. Individual identification
6. Date of birth
7. Number born — alive
8. Number born — total
9. Number of pigs in litter at 21 days
10. Adjusted 21-day litter weight
11. Date postweaning weight obtained
12. Actual postweaning weight
13. Actual backfat
14. Feed efficiency (if feed efficiency recorded, see items 14-18)
15. Composition of test group (number pigs, half sibs, full sibs, etc.)
16. Weight on test — total for group
17. Weight off test — total for group
18. Days on test
19. Feed consumed — total for group

#### *Data Output*

1. Include items 1-7 under Data Input
2. Adjusted 21-day litter weight (Ratio)
3. Days to 230 pounds (Ratio)
4. Backfat adjusted to 230 pounds (Ratio)
5. Feed efficiency (Ratio)
6. Composition of test group
7. Individual index(es) — identify which index(es)
8. Litter summary
9. Sire summary
10. Breed group summary
11. Contemporary averages

### Central Test Program

1. All entries to a test station should be from a validated brucellosis-free herd. Both breeders and their veterinarians should certify that the herd has been free of clinical evidence of swine dysentery, pseudorabies (PRV), tuberculosis, and brucellosis during the 6-month period before entry of the pigs at the test station. In the case of transmissible gastroenteritis (TGE), the period should be 60 days. Entries must be accompanied by the certification statement shown at the end of this appendix, and a current interstate health certificate.

2. All animals should be tested for brucellosis before sale.

3. Pigs should be vaccinated for erysipelas and five strains of leptospirosis (pomona, canicola, grippotyphosa, hardjo, and icterohaemorrhagiae) upon entry into the station and again before sale.

Until programs for the control of pseudorabies are defined more clearly, it is suggested that pigs entering test stations be tested and be serum neutralization (SN) negative for pseudorabies at the following times:

a. Within 30 days prior to entry into station or immediately on delivery at the test station. Pigs originating from an accredited PRV herd (where States have this program) will be allowed to be delivered to the test station without being tested SN negative for pseudorabies 30 days prior to delivery.

b. At the test midpoint (approximately 100 pounds or 35 days after initiation of test).

c. Prior to sale.

No pigs will be taken from herds that (1) show clinical signs of pseudorabies, (2) have had a positive fluorescent antibody (F.A.) test to PRV, (3) have had a PRV isolation, and/or (4) have had a positive reaction to the pseudorabies serum neutralization test. Pigs will not be accepted from such herds unless it is subsequently demonstrated that the herd is free of pseudorabies.

4. Test animals should be wormed with a compound proven effective for control of internal parasites during the adjustment period before starting on test.

5. Pigs should be treated for external parasites with an approved product upon entry into the station, 2 weeks later, and before sale.

6. If barrows are tested, pigs should be well healed from castration before acceptance into the station.

7. It is recommended that each station publish in each sale catalog and also post on the station premises a description of the health program followed at the station.

8. The following procedures are suggested for station operation:

- a. Move all pigs directly from farm of origin to the test station.
- b. Provide all visitors with station boots and coveralls during their visit.
- c. Allow no one to enter pens.
- d. Allow no visitors in pen area for 35 days after pigs are delivered.
- e. Establish a policy that the attending veterinarian may choose a live pig for postmortem examination to aid in arriving at a diagnosis in disease outbreaks.
- f. Work closely with station veterinarian on establishing sanitation procedures.
- g. Permit no visitors unless an attendant is present.
- h. Do not admit any pigs to station for 30 days prior to a sale.

#### On-Farm Program

The following items are herd health recommendations for on-farm testing programs:

1. All seedstock producer herds should be validated brucellosis-free.
2. All pigs sold should be vaccinated for erysipelas and five strains of leptospirosis, should be free of external parasites, and should have been subjected to a reasonable worming program. (See 3. and 4. in previous section, "Central Test Program.")
3. All pigs sold should be eligible for an interstate shipment permit.
4. Strict sanitation measures should be followed for all incoming traffic, such as scanning equipment, feed trucks, stock trucks, boar buyers, etc. Each farm should have its own scales.

#### Test Station Health Record

Dear Producer:

We are asking you to complete the following health history questionnaire regarding your breeding herd. The certificate must be signed by a veterinarian who is regularly involved with your swine health program.

This health certification statement must be returned with the contract of entry for the test station. Since valuable breeding animals will be gathered together into a new group, we must take all precautions necessary to protect the health of these animals. The spread of an infectious disease from the test station to a farm which purchased boars from the test station would be detrimental for

everyone involved. In the event your boars perform well in the test station and a demand is created for your stock, we want assurance that other animals in your herd possess the same level of health as the test station swine.

We recognize conditions change daily, but we consider this history important for the preservation of good will and integrity for the seedstock industry.

Please answer the questions concerning the specific diseases listed. Answer all with either YES or NO. These answers will be considered confidential but may be a basis for rejection of an entry.

Have any pigs on your farm been infected with any of the following diseases within the past 6 months?

- |                       |   |
|-----------------------|---|
| _____ Swine dysentery | _____ Tuberculosis (any slaughter house condemnation) |
| _____ Brucellosis     | _____ Pseudorabies                                    |

\_\_\_\_\_ Has your herd had any problem with TGE the past 60 days?

- |                  |                          |
|------------------|--------------------------|
| _____ Rhinitis   | _____ External parasites |
| _____ Erysipelas | _____ Acute pneumonia    |

\_\_\_\_\_ Have you had your herd inspected for the above diseases and/or conditions within the past 2 weeks by your local veterinarian?

I attest the above information is true.

\_\_\_\_\_  
Date

\_\_\_\_\_  
Producer's signature and address

I have this day inspected the breeding herd of origin and find the herd to be suitable for consideration for entry into the test station. I am regularly employed by the above client for veterinary services.

\_\_\_\_\_  
Date

\_\_\_\_\_  
Veterinarian's signature and address





